Effect of Reduced Drying and Extraction Time in Determining Meat Fat Content

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The AOAC method for determining the fat content of meat was modified so that it can be applied more rapidly by processors in controlling meat product composition. A saving of 4.25 hr in drying and extraction time was effected without any significant loss in accuracy. Collaborative studies are suggested to reduce the time requirements for the official fat analysis of meat.

The AOAC method (1) for determining the fat content of meat and meat products requires a minimum of approximately 7 hr, utilizing the most rapid of approved procedures, and up to 22 hr otherwise. A rapid method devised for removing solvent from extracts and preparing them for weighing can reduce this time approximately 50 min (2). Decreasing the time required in drying and extracting samples could considerably reduce costs of analysis and provide a relatively rapid method that the meat industry could use in controlling product composition. Hoffman (3) conducted a collaborative study to reduce the official extraction time from 8 hr or more to 4 hr. Recent investigators have compared rapid analytical methods of different approaches with the official AOAC method, without attempting to shorten the time required in using the AOAC method for meat and meat products (4–6). The results reported in this paper indicate that this can be accomplished in analyzing many types of meat samples.

METHOD

Apparatus and Reagents

(a) *Extraction.*—Goldfisch extraction apparatus and glassware.

(b) *Extraction thimbles.*—22 × 80 mm single thickness cellulose thimbles.

(c) *Solvent.*—Absolute ethyl ether.

(d) *Sea sand.*

Sample Preparation

Cut meat samples into ½″ cubes; grind in a meat chopper 3 times through plate with openings ≤⅛″, mixing thoroughly after each grind. Conduct all preparations with a prechilled sample and chopper assembly. Store samples in moisture-proof containers at 3°C until used.

Procedure

See 24.005(a). Weigh 3–4 g sample by difference in thimble, add small amount of sand, mix carefully around lower inner section of the thimble, and dry at 125°C for 1.50 hr. Carry out extraction as in 7.048 with absolute ethyl ether for 4 hr. Weigh extracted fat in Goldfisch beaker after complete removal of ether and calculate as per cent fat.

Modifications

The above procedure was used with the following changes: The drying time was varied from 1.50 to 0.08 hr; the extraction time was varied from 16 to 0.25 hr; both the drying time and the extraction time were also varied. The results were reported as per cent recovery as compared with results obtained using 7.048.

Results and Discussion

Lots A and C were commercially ground beef hamburger obtained from a local supermarket and reground in the laboratory. Lots B and D were boneless chuck steak obtained from the same source. Samples from 2 lots of fresh ground beef were analyzed for fat content by the official AOAC method for meat. Other samples from these lots were extracted for different lengths of time after drying at 125°C for 1.50 hr. Recoveries, as shown in Table 1, ranged from 91.9 to 101.0% for Lot A and 99.6 to 104.2% for Lot B. All extractions, except 0.25 hr extractions of samples of Lot A, were satisfactory (95% recovery or

Table 1. Recovery of fat from ground beef dried 1.5 hr at 125°C, with varied extraction time

Extn Time, hr	% Recovery[a]	
	Lot A[b]	Lot B[c]
16	98.0±2.4	
10	97.3±2.5	
8	99.6±3.6	
6	99.8±1.7	
4[d]	100.0±1.7	100.0±2.5
3	97.6±3.1	100.8±1.2
2	100.5±2.1	104.2±2.7
1	101.0±2.7	99.6±2.4
0.75	96.4±1.9	101.1±2.4
0.50	95.6±2.8	100.8±2.6
0.25	91.9±3.4	100.9±1.9

[a] % Recovery: (% fat found/% fat by AOAC) × 100.
[b] AOAC analysis = 24.4%, n = 6 for each extraction time.
[c] AOAC analysis = 19.5%, n = 6 for each extraction time.
[d] AOAC official analysis, minimum time for extraction.

better). Samples from 2 other lots of ground beef were analyzed by drying for periods ranging from 0.08 up to 1.50 hr and extracting for 1 hr. Recoveries, shown in Table 2, ranged from 94.8 to 99.5% (Lot C) and from 92.1 to 101.6% (Lot D). Only 0.08 hr drying proved inadequate.

From these data parameters were set up to evaluate the effects of changing both the drying and extraction times on the recovery of fat from various meat products.

A minimum time of 0.75 hr drying and 0.50 hr extraction was used for analyzing other types of meat cuts. Recoveries, shown in Table 3, ranged from 71.6 to 100.2%. Very lean beef trimmings such as cheek and neck meat do not release fat on ether extraction as readily as meats containing a larger per cent of fat. Very low fat content in meats may require a longer drying and extraction time.

Recoveries listed in Table 4 show that for ground beef combinations of 0.25 hr drying and 0.75 hr extraction, 0.50 hr drying and 0.50 hr extraction, 1.50 hr drying and 0.25 hr extraction were sufficient to produce adequate levels of recovery (consistently above 95%). For frankfurters 0.25 hr drying and 0.50 hr extraction and 0.50 hr drying and 0.25 hr extraction were sufficient. Pork trimmings required 0.25 hr drying and 0.25 hr extraction.

The reduction in time of analysis from 5.50 hr (official drying and extraction time only) to 1.25 hr, without significant loss in accuracy, can be very useful for both analysts and meat processors.

Table 2. Recovery of fat from ground beef, with varied drying time at 125°C and 1 hr extraction

Drying at 125°C, hr	% Recovery	
	Lot C[a]	Lot D[b]
1.50	98.5±2.1	—
1.00	96.4±1.4	99.4±1.9
0.75	99.5±2.8	101.6±2.5
0.50	98.9±1.7	101.6±2.1
0.25	96.7±2.7	98.8±3.4
0.17	96.5±3.0	99.2±2.7
0.08	—	92.1±3.1

[a] AOAC analysis = 28.1±0.3% fat, n = 3 for all samples.
[b] AOAC analysis = 19.5±0.5% fat, n = 6 for all samples.

The precision of this modification ranges from ±0.20 to ±0.80% fat.

Although the Soxhlet extraction apparatus yields similar results for 4 hr extractions, the Goldfisch apparatus is preferred because of its compactness, simple water and power hook-ups, and, most importantly, because it requires only 25–35 ml solvent as compared with 75–100 ml for a Soxhlet extraction. Petroleum ether yields results similar to those obtained with ethyl ether; however, the time required for drying the extracted fat was found to be longer.

It is suggested that a collaborative study be conducted on at least 5 types of economically important meat products, from low to high fat levels, to determine the analytical parameters of a rapid fat analysis within the acceptable accuracy of the official method. This procedure might then lead to a relatively rapid, accurate method that the meat industry could use in controlling product composition.

Table 3. Results of application of rapid method to various types of meat products

Sample	Fat Content, %[a]		Recovery, %
	Rapid Method[b]	AOAC	
Beef cheek	1.79±0.40	2.50±0.12	71.6±16.0
Beef neck	5.45±0.75	6.32±0.50	86.2±1.2
Beef navel (plate)	9.36±0.41	9.42±0.49	99.4±0.4
Beef tongue	15.75±0.72	16.23±1.33	97.0±4.4
Ground beef	18.44±0.60[c]	18.99±0.20	97.1±3.2[d]
Frankfurters	25.00±0.42[c]	24.95±0.22	100.2±1.7[d]
Pork trimmings	55.13±0.50[c]	55.16±0.34	99.9±0.9[d]

[a] Based on triplicate determinations.
[b] Rapid method: drying time 0.75 hr at 125°C, extraction time 0.50 hr.
[c] Rapid method: drying time 0.50 hr at 125°C, extraction time 0.50 hr.
[d] Based on 6 determinations.

Table 4. Effects of varying both drying time and extraction time on the recovery of fat (%)[a] from ground beef, frankfurters, and pork trimmings

Sample	Drying Time, hr	Extraction Time, hr				
		0.25	0.50	0.75	1.0	4.0
Ground beef	0.25	93.9±3.7	93.3±2.1	97.3±0.8	95.8±2.7	99.9±0.4
	0.50	92.1±2.4	97.1±3.2	100.5±1.3	97.5±1.5	99.0±0.1
	1.00	93.9±3.3	97.1±1.3	99.5±2.6	97.2±0.5	99.1±1.4
	1.50	99.1±3.2	97.1±1.6	99.5±1.4	98.4±1.8	100.0±1.1[b]
Frankfurters	0.25	94.2±1.6	98.6±13.4	97.4±2.6	100.2±1.4	101.6±0.7
	0.50	95.8±1.6	100.1±1.0	102.7±1.2	101.4±2.9	—
	0.75	99.2±1.7	100.2±1.7	101.2±0.6	99.1±1.8	—
	1.00	99.5±1.0	99.3±2.4	100.4±0.8	101.5±0.3	—
	1.50	100.3±2.0	100.7±1.4	100.6±1.1	—	100.0±0.9[c]
Pork trimmings	0.25	98.5±0.5	99.2±0.3	99.7±1.0	—	—
	0.50	99.6±1.5	99.2±2.4	99.0±1.4	—	—
	0.75	100.6±0.4	99.9±0.9	100.3±1.6	—	—
	1.50	—	—	—	—	100.0±0.6[d]

[a] % Recovery = (% fat found by rapid method /% fat by AOAC) × 100.
[b] AOAC official method; fat = 18.99±0.20%, n = 6; n = 3 for all other beef samples.
[c] AOAC official method; fat = 24.95±0.22%, n = 6; n = 3 for all other frankfurter samples.
[d] AOAC official method; fat = 55.16±0.34%, n = 6; n = 3 for all other pork trimmings samples.

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